



Analysis of Vegetation Index Variations and the Asian Monsoon Climate

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Abstract

Vegetation growth depends on local climate. Significant anthropogenic land cover and land use change activities over Asia have changed vegetation distribution as well. On the other hand, vegetation is one of the important land surface variables that influence the Asian Monsoon variability through controlling atmospheric energy and water vapor conditions. In this presentation, the mean and variations of vegetation index of last decade at regional scale resolution (5km and higher) from MODIS have been analyzed. Results indicate that the vegetation index has been reduced significantly during last decade over fast urbanization areas in east China, such as Yangtze River Delta, where local surface temperatures were increased significantly in term of urban heat Island. The relationship between vegetation Index and climate (surface temperature, precipitation) over a grassland in northern Asia and over a woody savannas in southeast Asia are studied. In supporting Monsoon Asian Integrated Regional Study (MAIRS) program, the data in this study have been integrated into Giovanni, the online visualization and analysis system at NASA GES DISC. Most images in this presentation are generated from Giovanni system.

Giovanni: <http://disc.gsfc.nasa.gov/giovanni>

Seasonal Variations of Normalized Difference Vegetation Index (NDVI) from MODIS

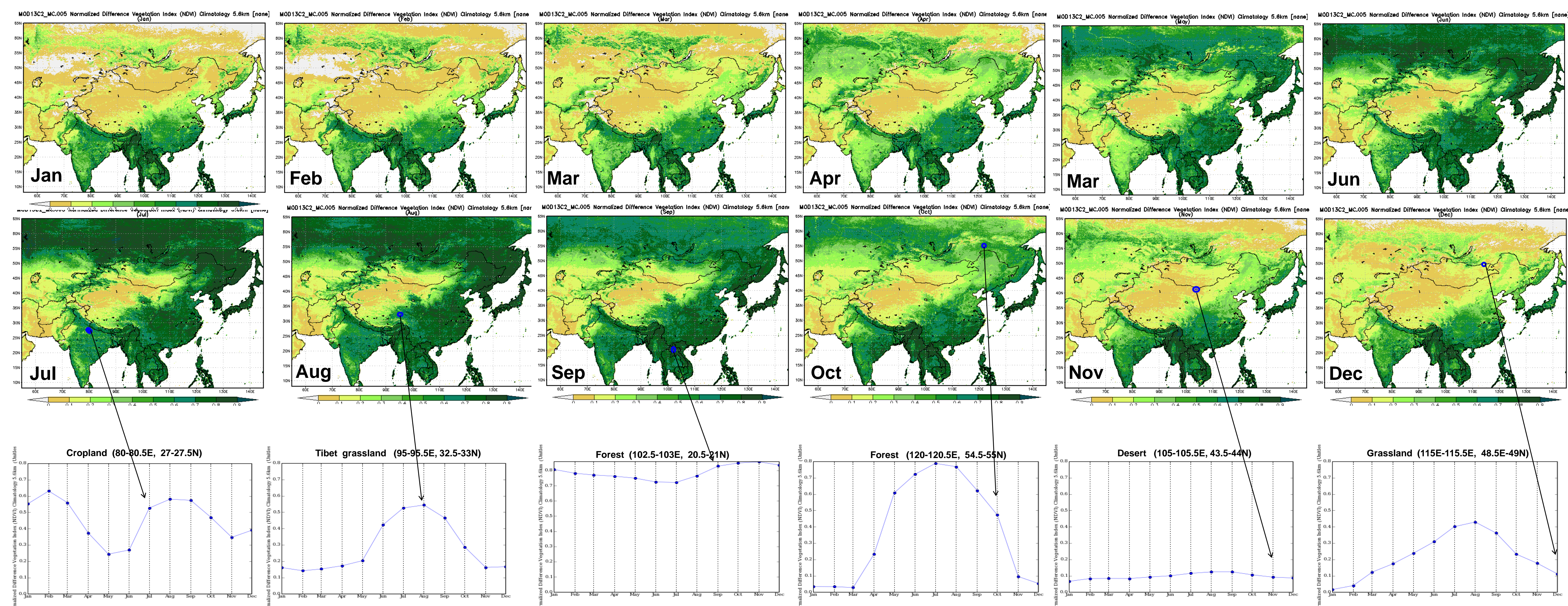


Figure 1: Images are monthly climatologies of NDVI at 5.6km resolution from MODIS-Terra. Time series show very different seasonal variations of the NDVI over different land cover types or different regions.

Interannual Variations of Vegetation Index and Local Climate

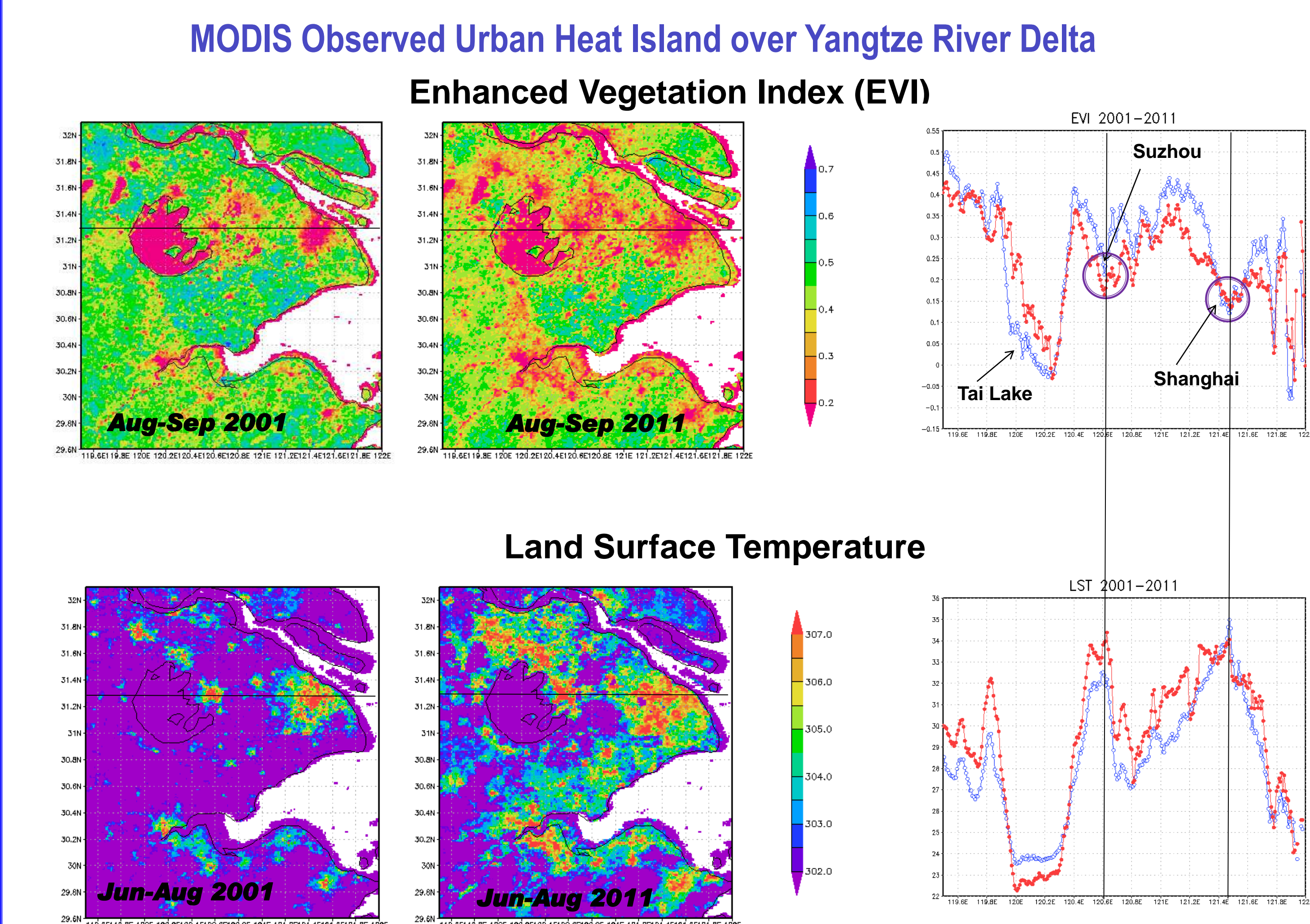


Figure 2: Enhanced Vegetation Index (EVI) (upper images) and Land Surface Temperature (LST) (lower images) are from MODIS-Terra at 1km resolution. The urbanization over Yangtze River Delta region is observed clearly as the increased area size of lower EVI (similar in NDVI) from 2001 to 2011 caused by turning cropland to urban. The local climate, in term of LST, has changed due to the land use changes. The area size of urban heat island (UHI) has increased significantly during the last 10 years.

The line plots are EVI and LST over a cross urban section near 31.3°N (black lines on images) for 2001 (blue lines) and 2011 (red lines), giving a different review of land use changes associated with urbanization and the local surface temperature changes.

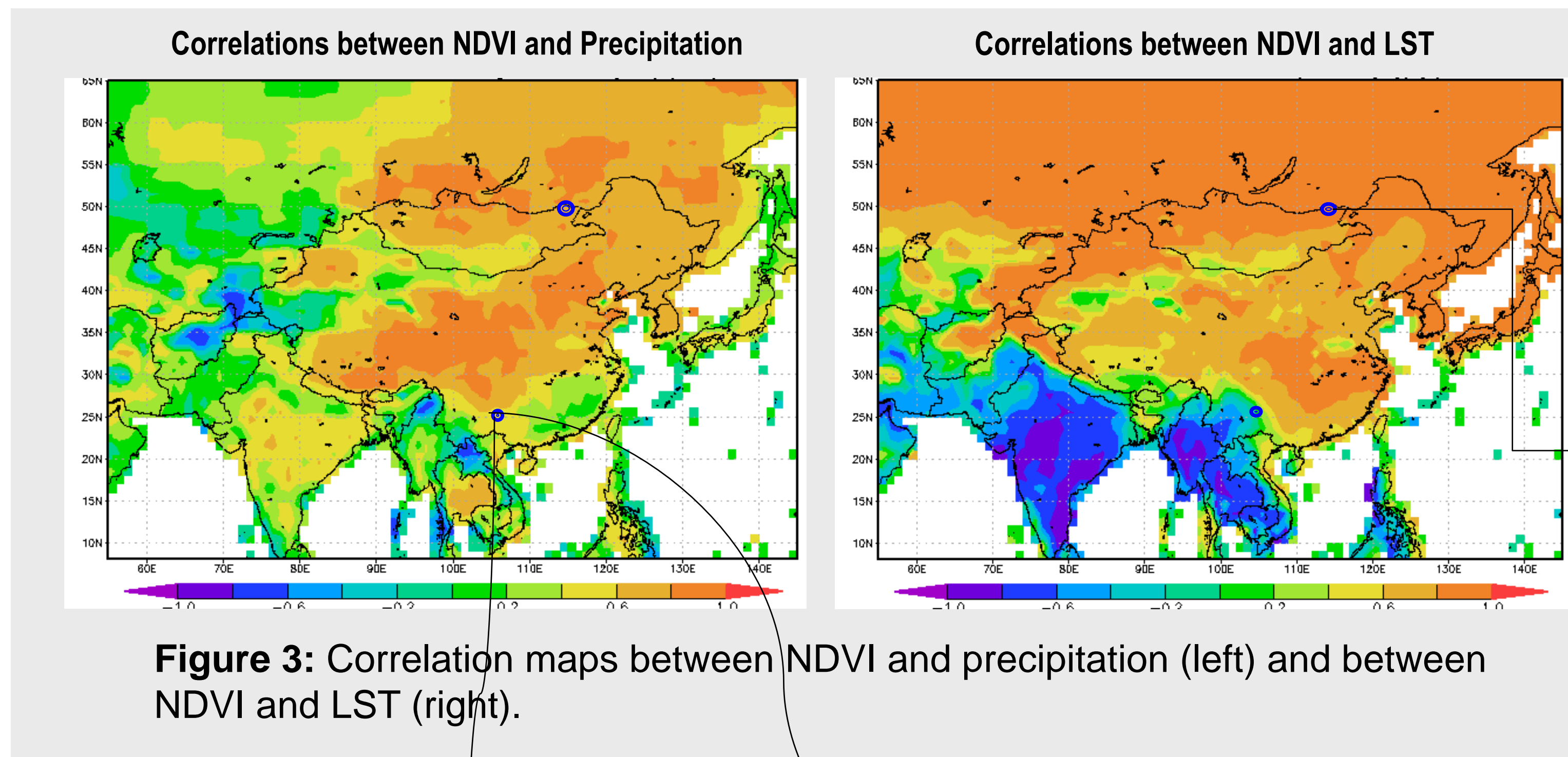


Figure 3: Correlation maps between NDVI and precipitation (left) and between NDVI and LST (right).

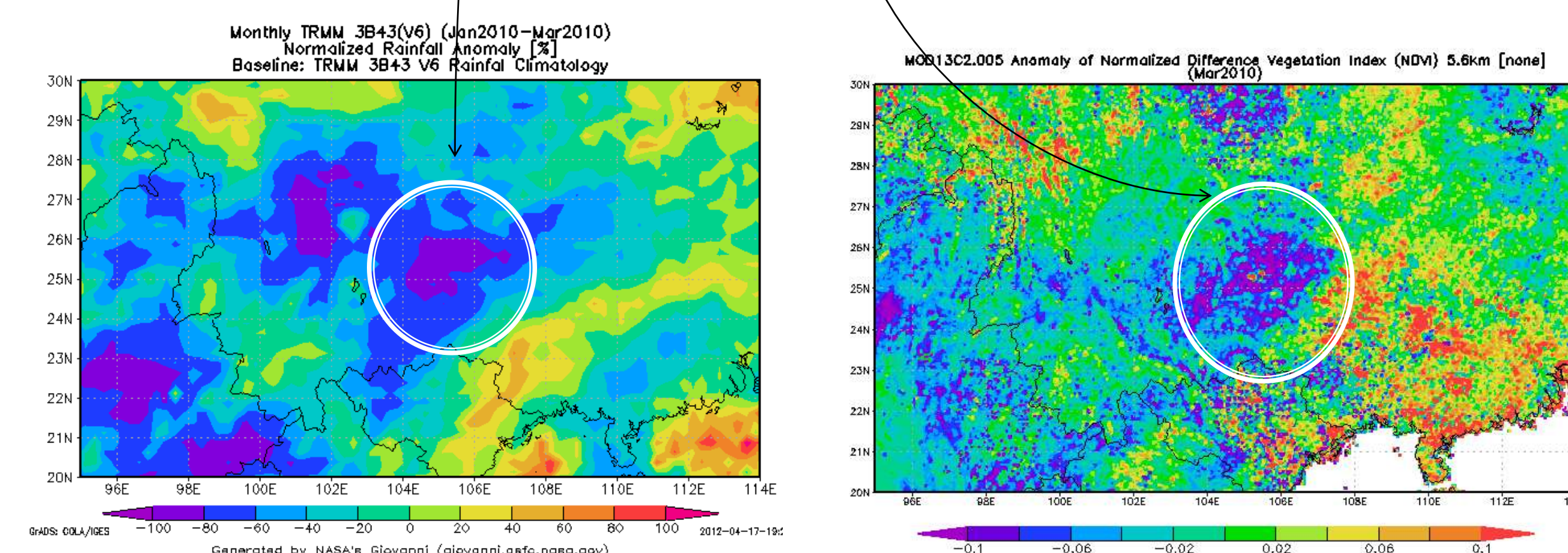


Figure 4: Severe drought happened in the winter and early spring of 2010 over southeast Asia. TRMM revealed that the accumulated precipitation was more than 70% below the normal in some regions (upper left). MODIS observed that the vegetation growth was weaker during the springtime of 2010 over the drought regions than normal years (upper right, and right).

Land Surface Temperature and NDVI over Grassland

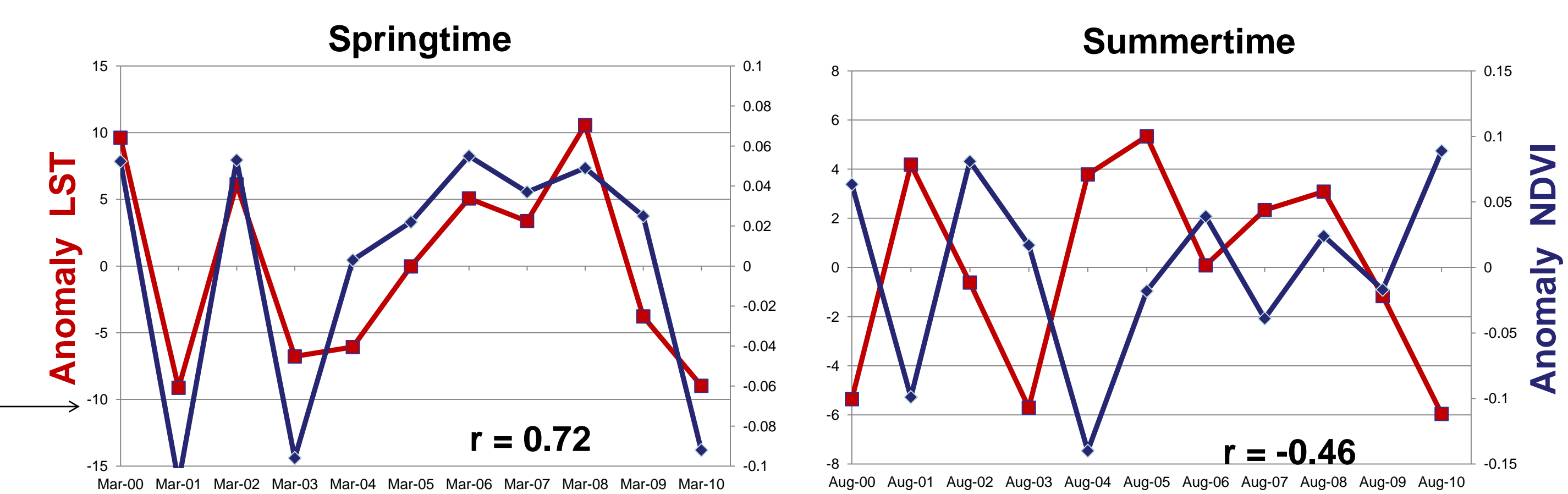


Figure 5: Time series are monthly land surface temperature (LST) (red lines) anomaly and NDVI (blue lines) anomaly over grassland in the northern Asia (48°N-49°N, 114°E-116°E) for March (left) and August (right). The NDVI is correlated to LST significantly over this region, but the relationship is positive during March, but is negative during August.

Summary:

Preliminary analyses results are:

- Over Monsoon Asia region, seasonal and interannual variations of vegetation index depend highly on the land cover types and location.
- The natural variations of vegetation index has a complicated relationship to the local climate. The correlations between NDVI and LST, and that between NDVI and precipitation, vary geographically and seasonally at some location.
- The human activities have caused significantly changes as well. Taken Yangtze River Delta region as an example, area of lower EVI (and NDVI) has expanded significantly from 2001 to 2011, associated with turning cropland into urban. The local LST were increased significantly in last 10 years over the areas converted to urban, resulting in increased UHI areas;

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